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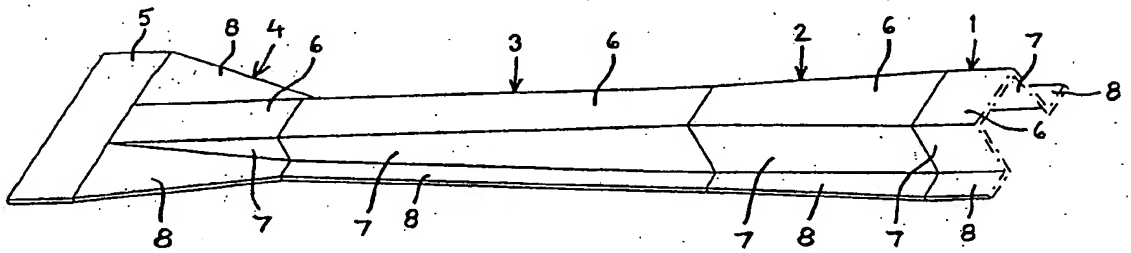
(54) Title: SAFETY BEAM



(57) Abstract

A bar construction, preferably intended as a vehicle-mounted safety bar to protect against collisions, particularly against side-on collisions, comprising a generally trapezoidal and open cross-sectional configuration which includes a centre-flange (6), two webs (7) which embrace the centre-flange, and side-flanges (8) which extend outwardly from a respective side of the bar and connect with a respective web (7). The bar may optionally include a first section (1) of constant cross-section in the centre part of the bar. The bar includes at least one second section (2) which has a centre-flange (6) whose width (b) decreases towards one end (5) of the bar. A transition part (3, 4) of generally trapezoidal configuration is provided between the second section (2) and the end (5) of the bar. The second section (2) has side-flanges (8) whose widths (c) decrease towards one end of the bar. The second section (2) has a generally constant height (h).

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SAFETY BEAM

TECHNICAL FIELD

The present invention relates to a bar construction, and preferably, but not exclusively, to a vehicle-mounted safety bar construction which provides protection in the event of collisions, in particular side collisions, said bar construction having a generally trapezoidal cross-sectional shape which is preferably open. The cross-sectional configuration of the bar includes a central flange which is embraced by two webs each of which has connecting therewith a respective side-flange which extends outwardly on a respective side of the bar construction.

BACKGROUND ART

Safety bar structures are used in several different aspects, although the use of such bars as a protective device in vehicles is the most usual. Another common application is the use of such bar structures as barriers along highways and roads to prevent vehicles from running off the road in the event of accidents.

A vehicle-mounted safety bar which is intended to counteract side-on collisions is known from Swedish Patent Specification SE-C-434 245. As described in this patent specification, the safety bar has a closed cross-section which is constant along the full length of the bar. From the aspect of manufacture, however, it is preferred to provide the bar with an open cross-section, therewith resulting in lower manufacturing costs and also lower surface treatment costs against corrosion, etc. Hitherto known safety bars of open cross-section, however, have not been satisfactory with regard to their energy-absorbing capacity in relation to the weight of the bars. Bars of open cross-section have been found to require very large wall thicknesses in order

to be able to withstand collision forces without tearing apart, i.e. so that the bar webs are not moved apart.

DISCLOSURE OF THE INVENTION

The object of the present invention is to provide a bar structure which is preferably intended as a vehicle-mounted safety bar for protection against side-on collisions and which has a generally trapezoidal, preferably an open cross-section and with which the drawbacks associated with hitherto known safety bars are eliminated. In cross-section, the inventive safety bar includes a centre-flange which is embraced by two webs with which a respective side-flange projecting out from each side of the bar connects. The inventive safety bar may include a first section of constant cross-section located in the centre part of the bar, from which the bar tapers outwardly towards both ends thereof. It lies within the purview of the invention, however, to omit this central first section, in which case the bar will taper towards its respective ends directly from the midway point of the bar. A one-sided bar also lies within the purview of the invention, however, by which is meant a bar which tapers from a larger cross-section out towards a narrowing cross-section, or tapers asymmetrically towards respective ends thereof.

The inventive safety bar is characterized in that it comprises at least one second section which includes a central flange whose width decreases towards one end of the bar. The height of this second section will preferably be constant and at least one of the bar webs may connect with an outwardly directed side-flange whose width decreases towards one end of the bar.

The inventive safety bar may also include at least one third section which is located between the second bar section and one end of the bar and which includes a central flange of generally constant width and having a height

which decreases towards one bar end. The inventive safety bar may also include at least one fourth section which is located between the third section and one bar end and which has a central flange of constant width and a height which decreases towards one bar end down to the metal-plate thickness of the bar.

The centre-flanges of respective sections will preferably lie in one and the same plane, whereas the side-flanges will lie in different planes which are inclined relative to one another in correspondence with the decreasing height of the bar towards said one bar end. It also lies within the purview of the invention, however, for the side-flanges in respective sections to lie in one and the same plane, wherein the centre-flange of respective sections will be located in different planes corresponding to the decreasing height of said flanges towards said bar end. The webs will preferably have the same height on both sides of the bar, although webs of different heights also lie within the purview of the invention, wherein the side-flanges may also be located in different planes. The centre-flange may also slope on both long sides of the safety bar, preferably by giving the bar web on one long side a smaller height than on the other long side when the side-flanges are located in one and the same plane.

Because the width of the centre-flange and the side-flanges of the second section decrease towards the bar end, and because the height of the optional third section and the optional fourth section also decreases, it is impossible, or at least difficult, for the bar web to be bent outwards and parted when the centre-flange is subjected to load. This prevents the safety bar from being flattened upon impact, or at least renders such flattening difficult.

Further details and characteristic features of the inventive safety bar will be evident from the following de-

scription made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in more detail with reference to the accompanying drawings, in which

Figure 1 is a perspective side view of an inventive safety bar, as seen in a direction towards its load absorbing side;

Figure 2 is a view of the safety bar shown in Figure 1 as seen immediately from its load-absorbing side;

Figure 3 illustrates the safety bar shown in Figures 1 and 2 as seen from one long side of the bar;

Figures 4 A-G illustrate alternative embodiments of the cross-sections of the safety bars shown in Figures 1 to 3; and

Figure 5 illustrates intrusions in respect of different safety bars as a function of a load exerted thereon and as a function of the energy absorption capacity of respective bars.

The safety bar illustrated in Figures 1-3 is symmetrical about a first central section 1, although the Figures illustrate solely that part of the bar which extends from one end thereof and slightly into the first section 1 at the centre of the bar. The bar has a generally uniform trapezoidal cross-section and includes proximal to the first section 1 on both sides thereof a second section 2 of constant height (h) and having a width (b) which decreases towards respective ends of the bar. Provided adjacent respective second sections 2 is a third section 3 of constant width (b) but whose height (h) decreases towards

respective ends of the bar. Respective third sections 3 are terminated at respective bar ends by a fourth section 4 of constant width (b) and a height (h) which decreases towards said bar end down to the metal-plate thickness of the bar. Respective fourth sections 4 carry a mounting part 5 by means of which the safety bar can be fitted to a vehicle, for instance, preferably in the sides or doors of the vehicle.

The trapezoidal cross-sectional shape of the safety bar in the first section 1 will be evident from Figure 1, from which it will also be seen that the bar includes a centre-flange 6 which is embraced by two webs 7 of mutually equal height. Each web 7 connects with a side-flange 8 which extends out from the safety bar on each side thereof, said two side-flanges 8 being located in one and the same plane. This cross-sectional configuration is also shown in Figure 4A. Respective webs 7 slope at an angle (v) to the vertical of the plane extending through the side-flanges 8, so that the centre-flange 6 will have a width (b) which is smaller than the distance between the inner edges of the side-flanges 8. In the illustrated case, the web 7 slopes at an angle (v) of 5°, although this angle may be 0-10°.

The bar cross-section in the second section 2 includes a centre-flange 6 which is of constant height (h) and whose width (b) decreases towards the end of the bar. In this case, the angle (v) at which the web 7 slopes is constant and is equal to the slope angle in the first section 1. The width (c) of the side-flanges 8 decreases in a direction towards the bar end. In the illustrated case, this decrease is about 33% of the width applicable to the first section 1. However, the width (c) of the side-flanges 8 may decrease by up to 60% of the width (c) applicable to the first section 1. In the illustrated case, the width (b) of the centre-flange 6 decreases by about 35% of the width (b) applicable to the first section 1. The centre-

flange 6 in the second section 2, however, is located in the same plane as that which extends through the centre-flange 6 in the first section 1. According to an alternative embodiment of the inventive safety bar, the first section 1 can be omitted, in which case the two second bar sections 2 will be connected to one another at their respective ends of greatest cross-section.

The cross-sectional configuration of the safety bar in the third bar section 3 includes a centre-flange 6 of constant width (b) and a height (h) which decreases towards the end of the bar. The centre-flange of the third section 3, however, is located in the same plane as the plane that passes through the centre-flange 6 in the second bar section 2. In the illustrated case, the height (h) decreases by about 50% from the height applicable to the second section 2. In this case, the web 7 slopes at the same angle (v) as in the first section 1 and the second section 2. The width (c) of the side-flanges 8 are constant in this case and equal to the narrower width (c) applicable to the second bar section 2.

The cross-sectional configuration of the bar in the fourth section 4 includes a centre-flange 6 of constant width (b) and a height (h) which decreases down to zero. In this case, the width (b) of the centre-flange is equal to the width of the flange in the third section 3. The centre-flange of the fourth section 4, however, is located in the same plane as that which passes through the centre-flange 6 in the third section 3. In the illustrated case, the height (h) decreases from the smaller height (h) applicable to the third section 3 down to the thickness of the metal plate at the end of the fourth section 4. The width of the side-flanges 8 increases towards respective ends of the bar. In the case of the illustrated embodiment, this increase is about 300% from the width applicable to the third section 3, so that the combined widths (b and c) of the centre-flange and the two side-flanges will equal the

width of the mounting part 5, which is flat and located in the same plane as that which passes through the centre-flange 6 of the fourth section 4.

The webs 7 in the various bar sections may slope at mutually different angles along the length of the bar, both between respective sections and within one and the same section.

Figures 4 B-F illustrate further cross-sectional configurations which are additional to the basic form illustrated in Figure 4A and which can be applied to an inventive safety bar. Figure 4G illustrates a cross-sectional configuration of a safety bar which includes a channel 9 which extends in the bar centre-flange and the bottom of which is located in the same plane as the two side-flanges 8. The two centre-flange parts 6.1 and 6.2 respectively each have the same form as that described earlier with respect to the single centre-flange 6 illustrated in Figures 1-3. Alternatively, the form of the centre-flange part 6.1 may deviate completely or partially from the form of the other centre-flange part 6.2. The divided centre-flange has a width (b) which extends between the outer web of the bar, while the remaining dimensions of the bar correspond to those described above with reference to Figures 1-3. A safety bar of this configuration is particularly suited in those instances when available vertical space is limited for mounting the bar to a vehicle, for instance, such as a vehicle door.

Because the centre-flange 6 of respective bar sections and the bar mounting parts 5 lie in one and the same plane, the illustrated safety bar obtains a flat load-absorbing side. When the safety bar is subjected to load acting in the direction of the arrow (p) in Figure 3, for instance when the vehicle is subjected to impact forces on that side thereof in which the inventive safety bar is mounted, the centre-flange 6 is subjected to pressure forces along

the length of the bar while the side-flanges 8 are subjected to tension forces. The centre-flange 6 may possibly buckle in a direction towards the interior of the bar. Because the width (b) of the centre-flange 6 decreases towards the end of the bar and the width (c) of the side-flanges 8 decrease in the second section 2 and the height (h) decreases in the third section 3 and in the fourth section 4, the webs 7 of the safety bar are prevented from bending outwards, or such bending is at least made difficult, so as to more or less flatten the bar. It also lies within the purview of the invention to arrange the side-flanges 8 in one and the same plane.

Figure 5 is a diagram which compares the energy-absorbing capacity, expressed in J/kg, of safety bars of different configurations. All of the safety bars concerned have a length of about 900 mm and a maximum height (h) of about 40 mm. The metal plate has a thickness of about 1.6 mm. The diagram illustrates bar intrusions in mm as a function of load in N. The safety bar takes-up energy with intrusions of up to 150 mm, whereafter the surrounding structure, for instance in the form of vehicle frame components, begins to take-up energy with intrusions of 150-300 mm. The weight in kg relates to the intrinsic weight of the bar and the energy taken-up by the bar in respective cases is represented by the area beneath its deformation curve. The curves I-V in Figure 5 relate to safety bars of equal lengths and of identical cross-sectional configuration and size at the centres thereof, the first section 1, and have the following remaining characteristics:

Curve I represents an inventive safety bar having a uniform first section 1.

Curve II represents an inventive safety bar which lacks a uniform first section 1.

Curve III represents a safety bar which has a uniform cross-section (similar to the first section 1) along the full length of the bar.

Curve IV represents a safety bar with which the width of the centre-flange 6 and the side-flanges 8 and the height of the webs 7 decrease linearly towards respective ends of the bar.

Curve V represents a safety bar in which the height of the webs 7 decreases from the centre of the bar linearly towards the ends thereof, and with which the centre-flanges 6 and the side-flanges 8 have a constant width.

It will be seen from Figure 5 that the inventive safety bars represented by curves I and II are able to absorb much more energy than the safety bar represented by curve III (66%), and have an even greater energy absorption capacity than the safety bar represented by curve IV (28%) and the safety bar represented by curve V (22%). The greater energy absorption capacity of the inventive safety bar is probably because tensile forces acting in the side-flanges 8 create a moment of force which strives to press the webs 7 in towards the bar interior. The magnitude of this moment of force depends on the reduction in the width (b) of the centre-flange 6 and the width (c) of the side-flanges 8 in the second section 2 of the inventive safety bar.

It should be pointed out that the configuration of the second section 2 is of central significance to the invention. The combined length of the first section 1 and the adjacent second sections 2 will preferably constitute about 20-30% of the total length of the bar. The third section 3 and the fourth section 4 together form a transition part of trapezoidal con-figuration located between the second section 2 and the bar end 5.

According to one embodiment of the invention, the bar is constructed generally symmetrically around the first section 1 along the length of the bar.

According to another embodiment, the bar is constructed along its length generally symmetrically around two mutually connected second sections 2, in which case the first section 1 is excluded.

It will be understood that the invention is not restricted to the illustrated and described embodiments thereof and that changes and modifications are conceivable within the scope of the following Claims.

CLAIMS

1. A bar construction, preferably a vehicle mounted safety bar for protection in the event of collisions, particularly side-on collisions, said bar having a generally trapezoidal and open cross-section which includes a centre-flange (6) which is embraced by two webs (7), and a side-flange (8) which extends outwardly on each side of the bar and connects with a respective web (7), wherein the bar optionally includes a first section (1) of constant cross-section in the centre part of the bar, characterized in that the bar includes at least one second section (2) which has a centre-flange (6) whose width (b) decreases towards one end (5) of the bar; and in that a transition part (3, 4) of generally trapezoidal shape is located between the second section (2) and said one bar end (5).

2. A bar construction according to Claim 1, characterized in that the second bar section (2) has side-flanges (8) whose widths (c) decrease towards one end of the bar.

3. A bar construction according to Claim 1 or 2, characterized in that the second bar section (2) has a generally constant height (h).

4. A bar construction according to any one of Claims 1-3, characterized in that the transition part includes at least one third section (3) which includes a centre-flange (6) of essentially constant width (b) and a height (h) which decreases towards one end of the bar.

5. A bar construction according to Claim 4, characterized in that the transition part comprises a fourth section (4) which includes a centre-flange (6) of essentially constant width (b) and a height (h) which decreases

towards one end of the bar down to the metal plate thickness of said bar.

6. A bar construction according to any one of Claims 1-5, characterized in that the centre-flanges (6) of respective bar sections lie in one and the same plane.

7. A bar construction according to any one of Claims 1-5, characterized in that the side-flanges (8) of respective bar sections lie in one and the same plane.

8. A bar construction according to any one of Claims 1-7, characterized in that the centre-flange (6) includes a channel (9) whose bottom may lie in the same plane as one or both of the side-flanges (8).

9. A bar construction according to any one of Claims 1-8, characterized in that the bar is constructed generally symmetrically along its length around the first bar section (1).

10. A bar construction according to any one of Claims 1-8, characterized in that the bar is constructed generally symmetrically along its length around two mutually connected second bar sections (2), said first bar section (1) being excluded from the bar construction.

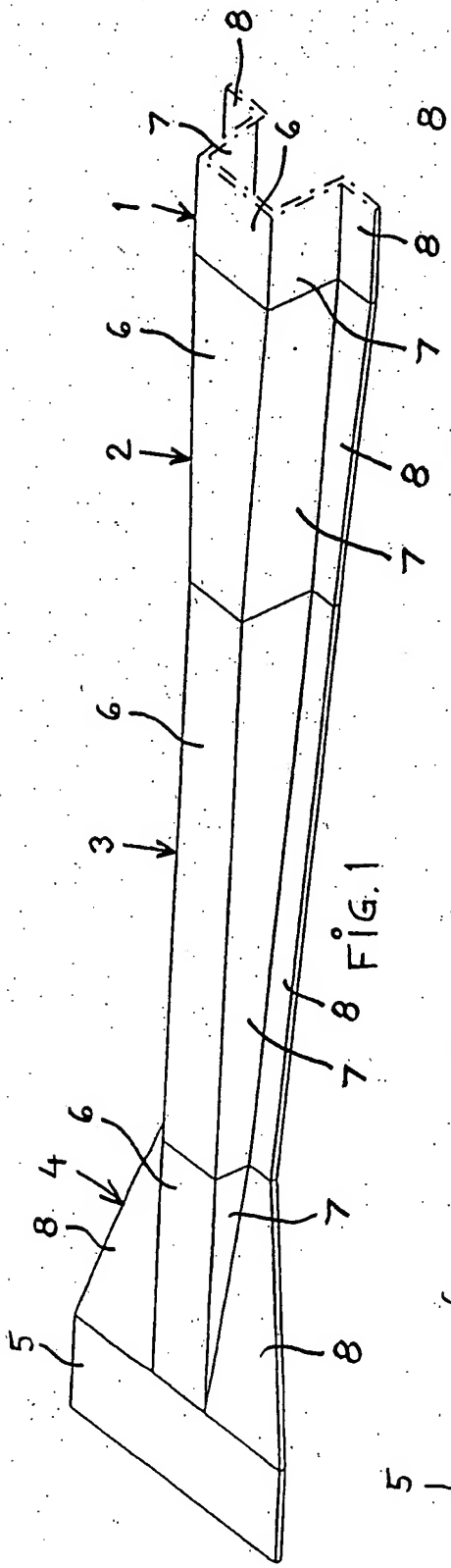


FIG. 1

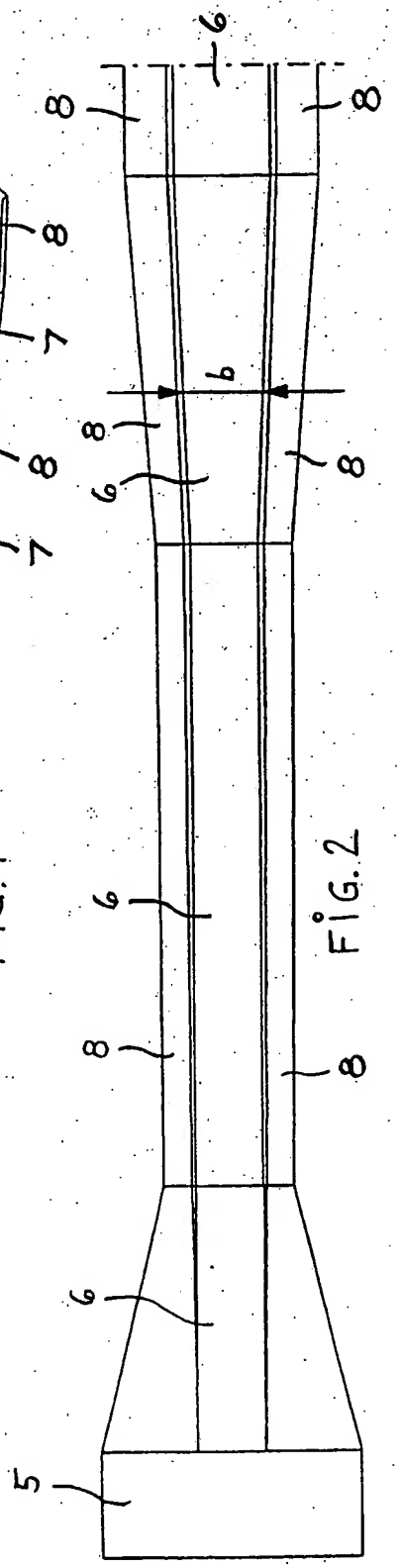


FIG. 2

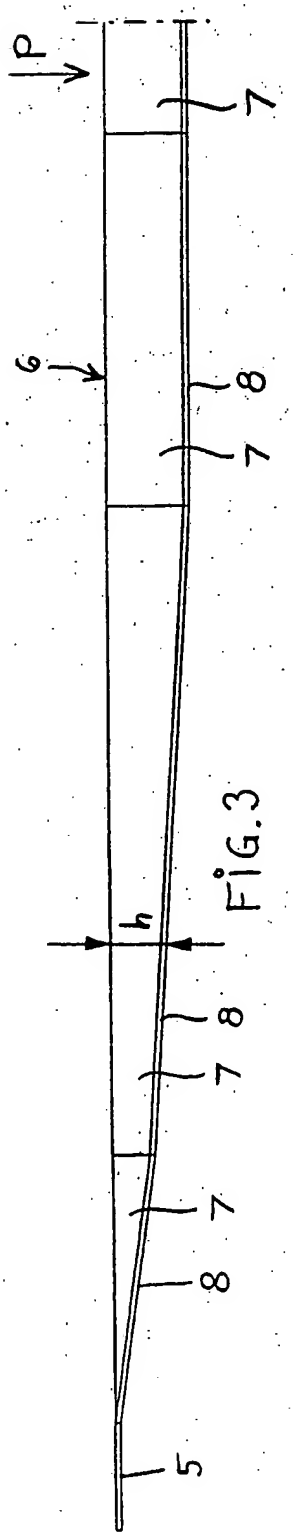


FIG. 3

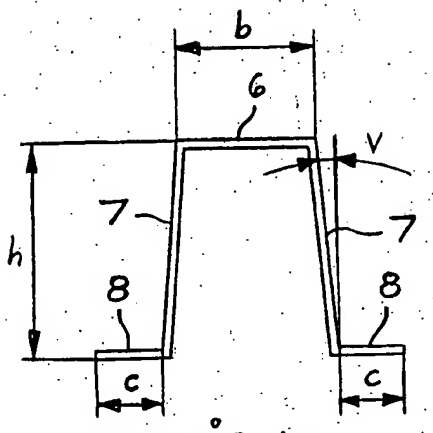


FIG. 4A

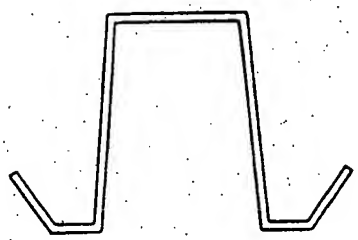


FIG. 4B

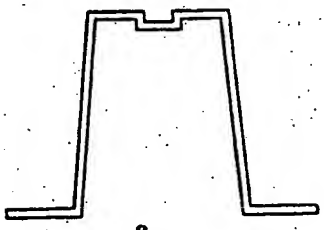


FIG. 4C

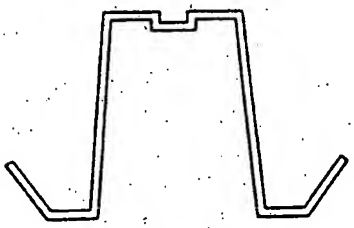


FIG. 4D

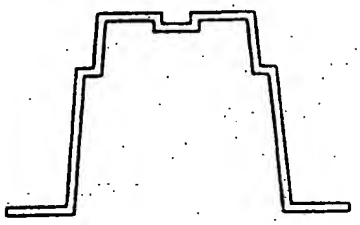


FIG. 4E

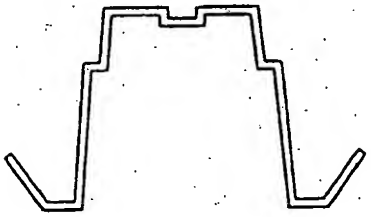


FIG. 4F

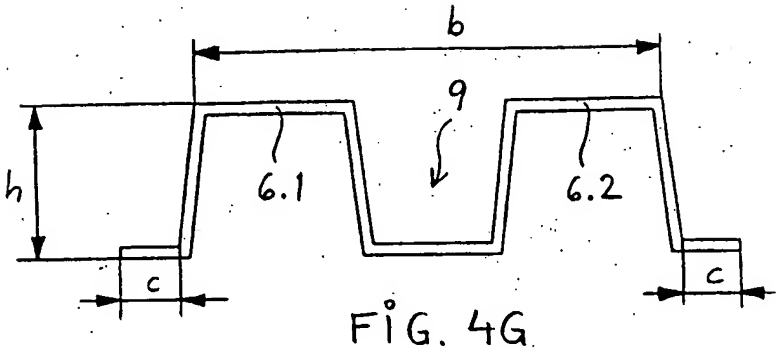
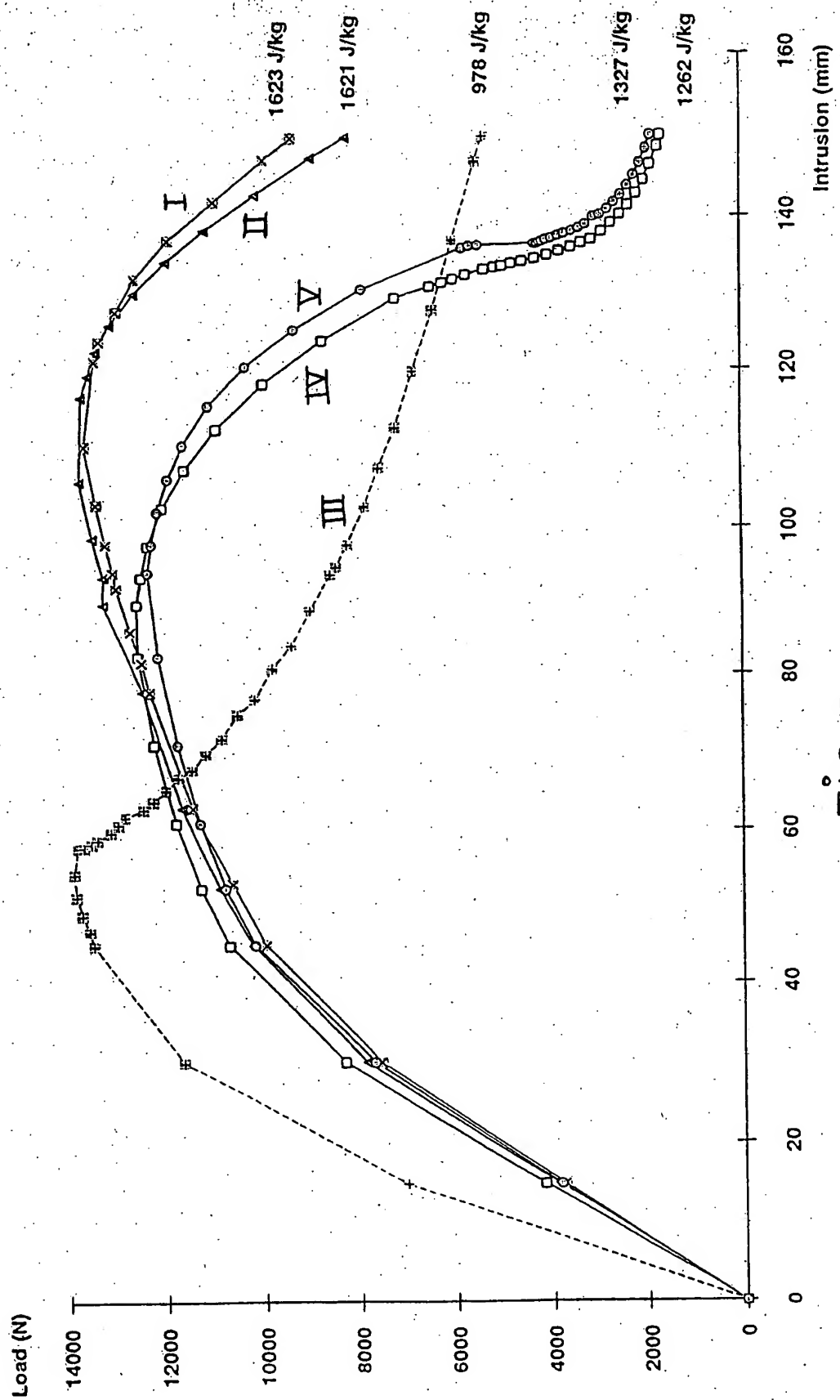


FIG. 4G


Load (N)
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12000
10000
8000
6000
4000
2000
0
0
20
40
60
80
100
120
140
160
Intruslon (mm)
1623 J/kg
1621 J/kg
978 J/kg
1327 J/kg
1262 J/kg
I
II
III
IV
V

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00760

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: B60R 19/42, E01F 15/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: B60R, B60J, B62D, F16S, E01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim N
X	US, A, 4838606 (FURUBAYASHI ET AL), 13 June 1989 (13.06.89), column 2, line 15 - column 3, line 8	1,3,7-9
Y	--	4-6
Y	FR, A1, 2207039 (REGIE NATIONALE DES USINES RENAULT; AUTOMOBILES PEUGEOT), 14 June 1974 (14.06.74), page 2, line 24 - line 37	4,5
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Y	US, A, 4948196 (BABA ET AL), 14 August 1990 (14.08.90), column 2, line 57 - column 3, line 9	4-6
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 December 1993	04 -01- 1994
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Hans Nordström Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00760

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim N
A	US, A, 4796946 (WILSON ET AL), 10 January 1989 (10.01.89)	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

27/11/93

International application No.
PCT/SE 93/00760

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US-A- 4796946	10/01/89	NONE	